UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, Ca. 94105

June 7, 1991

MEMORANDUM

SUBJECT: Request for Removal Action Approval at the Bluewater Uranium Mine Sites, Prewitt, Navajo Nation, New Mexico
ACTION MEMORANDUM
CERCLIS ID: PENDING
Site ID:W3
Category of Removal: Time Critical
Nationally Significant or Precedent Setting: Yes

FROM: Robert Bornstein RB
On-Scene Coordinator, Emergency Response Section (H-8-3)

TO: Jeff Zelikson
Director, Hazardous Waste Management Div. (H-1)

I. ENDANGERMENT FINDING

This is to request funding approval for CERCLA funded site activities at the subject site. Conditions presently exist at the site which, if not addressed by implementing the response action documented in this Action Memorandum, could cause the local population and wildlife to be exposed to unsafe external gamma radiation and radionuclides.

II. SITE CONDITIONS AND BACKGROUND

A. SITE DESCRIPTION

1. Removal Site Evaluation

On October 3, 1990, the Emergency Response Section (ERS) was notified by the Agency for Toxic Substance and Disease Registry (ATSDR) of the potential health hazards associated with the uranium mine tailings located at the Brown-Vandever-Nanabah Mines and Navajo-Desiderio Mine, (the Bluewater Uranium Mine Sites). After collecting limited data and conducting several Site visits, ATSDR concluded that the Sites may pose a significant health hazard to the local population because of the presence of radioactive mine tailings, physical hazards, and potential for heavy metal contamination. As a result of their investigation,

ATSDR issued a Public Health Advisory pursuant to Section 104(i)(6)(H) of CERCLA concerning the Sites on November 21, 1990

EPA Region IX ERS was tasked to assess the present radiological and geochemical conditions at the Sites to determine if an emergency response action is warranted. On November 15-16, 1990, ERS conducted a field gamma survey and collected water and soil samples. In addition, a radon flux measurement was performed on tailings at the Desiderio Mine site.

2. Physical Location

The Brown-Vandever-Nanabah and Navajo-Desiderio mine sites are located approximately five miles west of Prewitt, New Mexico (see attached maps, Appendix A). The sites lie within the Ambrosia Lake subdistrict of the Grants Uranium Mining District. The Brown-Vandever-Nanabah site encompasses approximately 155 acres. Half of this area has been disturbed and scared as a result of uranium mining. The Navajo-Desiderio site covers approximately 130 acres, with nearly 60 acres disturbed by mining activities.

The sites are located on four Indian Allotments and one parcel of Federal land which is administered by the Bureau of Indian Affairs. The mines were operated periodically from 1952-1970 by several mining firms.

The uranium ore is primarily calcium carnoite, $CaO\text{-}2UO_3\text{-}V_2O_5\text{-}nH_2O$, which disseminates through the Jurassic Todilto limestone. Operations at both mine sites consisted of both open pits and underground mines. Open pit mining was conducted predominantly with large front end loaders and haul trucks. The overburden, consisting of topsoil, alluvium, shale and sandstone was blasted, removed and placed in waste piles. Underground mining was conducted by driving adits to the ore zones within the limestone deposit. Ventilation holes and adits are present at both sites. It is estimated by the Navajo Nation that 25,000 tons of uranium ore was removed from these sites. Mined ore which failed to contain significant quantities of uranium were discarded at the mine sites; and no formal reclamation program was undertaken after mining operations ceased.

Because of the dry climate and lack of chemical weathering, these tailing piles remain exposed and the landscape remains scared.

3. Site Characteristics

Several families live and work on both sites. Approximately forty people, including children, live at the Brown-Vandever-Nanabah site and approximately fifty people live at the Desiderio site. Presently, the land is primarily utilized for grazing of local horses, sheep and goats. Throughout the year, the sheep and goats are allowed to roam freely within the mined areas. At the Brown-Vandever-Nanabah site, several homes are situated within a quarter mile from exposed uranium ore. At the Desiderio

site, several family homes surround the mined area.

Presently there are no restriction preventing the local population or livestock access to the tailing piles or mine shafts. The local population often use the tailing piles as observation posts when herding livestock. Local children are known to play on or around the tailings and near the mine shafts. There is also evidence that many of the home owners utilized mine tailing as foundation materials for their structures.

4. Release or Threatened Release into the Environment of a Hazardous Substance, or Pollutant or Contaminant.

On November 15-16, 1990, ERS collected soil, water and air samples at both mine sites. Each mine area was divided into sections and subdivided into sampling stations. Background gamma radiation readings, taken at approximately two miles from the Brown-Vandever-Nanabah site at ground level, were recorded at 11 microroentgens per hour (uR/hr). On Site, readings at ground level ranged from 13 uR/hr at the home sites to 1250 uR/hr within stripped mine pits and 10 uR/hr to 650 uR/hr at waist levels, respectively. Overall, ground level gamma radiation readings within the scared mined areas were recorded to be above 300 uR/hr and waist level readings above 200 uR/hr. At the Desiderio site, the net radiation levels ranged from background to over 350 uR/hr at waist level and over 850 uR/hr on ground contact. Waist level measurements are indictative of human exposure levels and contact measurements suggest the emission rate of the radioactive materials.

Soil samples collected and analyzed for both radium (Ra-226/228) and uranium isotopes (U-233/234/235/238) showed that there were high levels of these radionuclides present within the surface soils. The maximum levels of radioisotopes detected within the top 15 centimeters at the Brown-Vandever-Nanabah site for radium was in excess of 260 picocuries per gram of soil (pCi/g) and for uranium, the maximum level exceeded 390 pCi/g. Similar concentrations of radionuclides were detected at the Desiderio site.

Radon (Rn-222) flux measurements from waste piles were also measured at several stations within the Desiderio mine site. These results revealed that the maximum emission rate of radon was 67 pCi per square meter per second.

No elevated heavy metal concentrations were detected during the November assessment. In addition, potable water samples obtained from taps at both sites indicated that the amount of detected radionuclides were below the Primary Drinking Water Standards.

ATSDR, after review of the data collected by ERS, has concluded (4/22/91 Health Consultation) that the radiation exposure levels at the mine sites poses a severe radiological health hazard to individuals that frequently spend time on the tailings. ATSDR concluded that individuals that frequently work, play or

cross the tailing piles may receive a yearly external radiation exposure of over 100 millirem per year (mrem/yr). The National Council on Radiation Protection and Measurements (NCRP) recommends that continuous or frequent annual external radiation exposure to a population should not exceed 100 millirem per year (mrem/yr) above natural background (cosmic rays, alpha, beta and gamma sources). Population exposed to larger doses could be subjected to an increase cancer rate greater than 1 in 10,000. Both EPA's Office of Air and Radiation and the Department of Energy support the NCRP recommendations.

Several promulgated standards for radioactive material were found to be exceeded by ERS. Soil sampling data indicated that the levels of radium-226 in the top 15 cm of soils exceeds the regulatory limits established in 40 CFR 192. In addition, the radon-222 emission rates exceed the guidelines of 20 pCi per square meter per second outlined in 40 CFR 192.

The radionulides present within the soil are "hazardous substances" as defined in Section 101(14) of CERCLA, 42 U.S.C. Section 9601(14).

The local population are potentially being exposed to the radiation through the following pathways:

* Inhalation of radon daughters (decay isotopes);
* Direct exposure to elevated gamma radiation;
* Inhalation and ingestion of airborne radioactive particles, including alpha emitters.
* Ingestion of contaminated meat

5. NPL Status

The two mine sites are not currently on the National Priority List. As a result of the Health Advisory, the Navajo Superfund Office, with assistance from EPA Region IX Site Evaluation Section, is presently reviewing the sites using the Hazard Ranking Scoring model.

6. Maps, Pictures and Other Graphic Representations

Appendix A contains a map of the location of the Sites and a copy of the ATSDR Health Advisory and Health Consultation.

B. OTHER ACTIONS TO DATE

1. Previous Actions

As discussed, the two sites were initially referred to EPA ERS by ATSDR in October of 1990. At that time, ATSDR was preparing to issue a Public Health Advisory. EPA ERS was tasked to complete a preliminary investigation at the Sites to determine if an emergency removal action was warranted.

In order to prepare for this investigation, ERS consulted with the Office of Air and Radiation Region IX and Las Vegas

laboratory, Navajo Superfund Program, ATSDR, and the Indian Health Services. A site specific sampling plan was drafted and reviewed by the various interagency representatives.

On November 15-16, ERS, accompanied by members of the Office of Air and Radiation-Las Vegas Laboratory, EPA's Technical Assistance Team (TAT) contractor, Ecology and Environment, and members of the Navajo Superfund Program conducted an extensive gamma radiation and radionuclide assessment.

Soil, water and air samples were collected during the assessment and analyzed by Eberline Laboratory in Alburquerque, New Mexico. The data was received by EPA ERS in January of 1991.

To assist ERS Region IX in interpreting the results of the radiological survey, copies of the assessment data were forwarded to Bill Nelson, Region IX ATSDR Coordinator, Richard Guimond, Director of the Office of Air and Radiation, and Stephen Luftig, Director of the Environmental Response Division. ERS requested assistance in determining if the sites posed an acute (need to do a removal action) or a chronic (remedial action more appropriate) health risk.

In addition to reviewing the data, ERS began to research and investigate the historical records of the mine sites in order to determine potential responsible parties.

ERS notified William Allen, Regional Environmental Assistant for the Department of Interior about the sites and forwarded copies of the assessment data to the Bureau of Indian Affairs, Bureau of Land Management, and Indian Health Service. To acquire site specific lease information, a CERCLA 104E letter was issued to the Bureau of Indian Affairs, Navajo Office. In addition, a copy of the assessment data was forwarded to the Department of Energy, Grand Junction, Colorado.

On April 8, 1991 members of the Bureau of Indian Affairs (BIA), Bureau of Land Management (BLM), Office of Surface Mining, Indian Health Service (IHS) and the Navajo Nation met to discuss the sites. The various representatives provided background on the sites and their activities to date. In addition, potential response actions to reduce the radiological hazards were discussed including mine reclamation activities.

2. Current Actions

On April 22, 1991, ERS received ATSDR's Health Consultation concerning the assessment data. ATSDR concluded the following:

* radiation exposure at these sites could result in adverse health effects depending on the amount of time spent in radioactively contaminated areas. The residential areas appear to be relatively safe; whereas, if much time is spent in areas containing the waste piles, an imminent health problem could surface.

* Radionuclide concentrations within the top soil and radon gas emissions at the sites exceed the promulgated standards.

* Heavy metals do not pose a health hazard to the residents as initially believed in the Public Health Advisory

ATSDR recommended that additional radiological data be collected at the sites to further assess radon gas emissions, livestock and biota uptake. In addition, the Agency recommended that appropriate measures be immediately undertaken to effectively restrict site assess to the local population or reduce the amount of radiological emissions.

On April 15, 1991, the Office of Air and Radiation responded to ERS's request for technical assistance in interpreting the assessment data. Based on the data and information gathered during the assessment, OAR determined that a significant risk may be posed at least one of the sites. However, OAR was not able to conclude without additional data whether the sites pose an acute or chronic threat. OAR recommended that additional data be collected to further assess the radiological hazards. OAR has directed its Las Vegas Laboratory to draft a sampling and data analysis workplan for assessing releases of radionuclides into pathways not addressed during ERS's assessment. The Las Vegas laboratory plans to assess the amount of radon and gamma-ray exposure in homes, radon emanating from mine vents, and radionuclides entering the food chain.

Considering ATSDR's and EPA's concerns, and the lenghth of time that it could take EPA to determine which authority to use to address the conditions at the sites, ERS has decided that the most prudent course of action is to pursue a response action at the sites which would address the most significant radiological hazards. Once this "hot spot control" action is complete, EPA could then continue to investigate and study the sites to assess if additional actions are required.

C. STATE AND LOCAL AUTHORITIES' ROLES

1. State and Local Actions to Date

The Navajo Superfund Program has been actively investigating both sites since 1989. As part of the pre-remedial process authorized under CERCLA, the Navajo Superfund Program has conducted Preliminary Assessment (PA) reports for both sites in 1990. After review of the PA reports, the Navajo Superfund Program referred the sites to EPA Region VI Site Evaluation Section.

EPA Region VI Site Evaluation Section recommended high priority Screening Site Inspections (SSIs) in August and Septem-

ber of 1990. In October, 1990, under a new Interagency Agreement, EPA Region IX became the lead agency overseeing the Navajo Nation.

The Navajo Superfund Program assisted ERS in conducting its assessment in November of 1990. The Navajo Superfund Program reviewed and commented on ERS's work and sampling plans. During the assessment, representatives of the Navajo Superfund Program accompanied ERS in the field and helped communicate with the local population.

In addition to assisting ERS with its investigation, the Navajo Superfund Program has conducted several independent studies at the sites. In November of 1990, the Navajo Superfund Program conducted a limited home radon gas study. The data obtained revealed that radon gas within homes at the sites does not appear to be a problem. However, samples collected from carbon canisters placed near mine vents contained extremely high radon concentrations.

2. Potential for Continued State/local Responses

The Navajo Superfund Program is continuing its investigation at the sites. In April of 1991, the Navajo Superfund Program completed an Air Pathway Risk Assessment report for the Brown-Vandaver-Nanabah Mines and determined that the sites posed an increase cancer risk from particulate dispersion.

The Navajo Superfund Program has stated that it will continue to assist EPA in conducting community relations and radiological investigations. However, the Navajo Superfund Program does not pose the resources or finances to perform a response action at the sites.

III. Threat to Public Health or Welfare or the Environment

A. Threats to Public Health or Welfare

Pursuant to Section 300.415(b)(2) of the National Contingency Plan (NCP) the following conditions necessary for initiating a removal action exist:

1. Actual or potential exposure to hazardous substances or pollutants or contaminants by nearby populations, animals, food chain -- Without immediate action, the local population may be exposed to dangerous doses of gamma radiation and elevated concentrations of radionuclides.

Constant or frequent exposure to elevated gamma radiation is known to cause cancer, life span shortening and cataracts. The inhalation of radionuclides exposes internal organs to damaging alpha particles. Uranium and several of its decay daughters are alpha radiation emitters. Once ingested, the alpha particle is trapped within the body and can cause severe organ damage and genetic defects. Radiation is a known carcinogen, mutagen and teratogen.

2. High levels of hazardous substances or pollutants or contaminants in soils largely at or near the surface, that may migrate -- Elevated concentrations of radionuclides exist within the soils present at the mine sites. As a result of frequent high winds, these contaminants are being dispersed and migrating.

3. Weather conditions that may cause hazardous substances or pollutants or contaminants to migrate or be released -- Although the area is relatively dry, the Bluewater District is often subjected to severe thunderstorms and flash flooding. As a result, the mine tailings are slowly being broken down and transported both by alluvial and fluvial forces.

4. Availability of other appropriate Federal or State response mechanisms to respond to the release-- The Navajo Superfund Program has informed EPA that the cost to stabilize the sites exceeds their response capability.

B. THREATS TO THE ENVIRONMENT

The high emissions of gamma radiation being emitted from the tailing piles may adversely effect the local biota and wildlife. As stated, the land is primarily utilized as grazing grounds for local sheep and goat herds. It is probable that the radionuclides are entering into the local food chain as the livestock ingests the contaminated biota.

IV. ENDANGERMENT DETERMINATION

Actual or threatened releases of hazardous substances from this Site, if not addressed by implementing the response action selected in this Action Memorandum, may present an imminent and substantial endangerment to public health, or welfare, or the environment.

V. PROPOSED ACTIONS AND ESTIMATED COSTS

A. PROPOSED ACTIONS

1. Planned Action

To reduce the immediate potential radiological hazards associated with the two mine sites, ERS proposes to conduct the following response action:

Phase 1

For areas with frequent public and grazing use, grade and apply earth cover to areas emitting gamma radiation greater than 150 uR/hr above background;

Phase 2

Fill, seal and cap mine adits, inclines and ventilation shafts to reduce radon gas emissions;

Phase 3

For areas with limited public use, post signs warning of radiological hazards in English, Spanish, and

Navajo.

A guideline of 165 uR/hr (150 uR/hr above background) was selected using the following standard and assumptions:

Standard

* The National Council on Radiation Protection recommends that the continuous or frequent annual radiation exposure from all sources to a population should not exceed 100 mrem/y; the limit of 500 mrem/yr should be applied for an infrequent (short-term) annual exposure. To ensure that the population does not exceed the 500 mrem/yr limit for all sources, the population should not be exposed to over 100 mrem/yr of excess gamma radiation. With gamma radiation, 1 rem is approximately equal to 1 R .

Assumptions

* ERS assumes that the average population spends 2 hrs a day within the affected zones for approximately 300 days out of the year. Natural background is estimated to be approximately 15 uR/hr.

* If exposed to an area emitting 165 uR/hr for the total time spent within the affected areas, the population would receive the following gamma radiation exposure:
  165 uR/hr - 15 uR/hr = 150 uR/hr above background
  150 uR/hr * 2 hr * 300 per year = 90,000 uR/yr excess exposure

Therefore, the population would be exposed to approximately 90 mrem/yr excess gamma radiaiton.

Levels below 165 uR/hr including background are considered to be within the acceptable yearly exposure range and do not warrant a removal action.

Since, at this time, EPA does not have any set promulgated radiological action levels for conducting removal actions, ERS believes this calculation will be effective in mitigating any immediate radiological hazards present at these sites. However, this method of selecting "hot zones" may not necessarily be used to select future radiological areas on these sites or future similar sites.

Phase 1 Activities

ERS has estimated that a total of 25 acres of mine tailings, will require covering at the Brown-Vandever-Nanabah location and approximately 5 acres will need to covered at the Desiderio site. A more thorough and complete gamma survey will be conducted at the two mine sites to further define and identify areas exceeding 165 uR/hr. The earth cover will include two layers; 1 one foot layer composed of low porosity shale or mud, and the other, composed of topsoil. This cover specification was selected using the Nuclear Regulatory radon attenuation model and should adequately reduce the amount of both radon and gamma emissions.

The covering operation will employ the use of several large earth moving tractors and equipment. ERS estimates that three D-9 tractors, equipped with earth rippers, two large graders, a large sheep foot compactor, several large earth scrapers and water trucks will be required. The cover material, clay and top-soil, will be removed and transported to the sites from neighboring Bureau of Land Management land. Finally, after the cover is applied, the treated areas will be hydroseeded to control erosion and rain run-off.

ERS plans to work closely and consult the Bureau of Land Management, the Bureau of Indian Affairs and Office of Surface Mining in coordinating and implementing phase 1 activities.

Phase 2 Activities

Phase two operations will consist of backfilling and sealing open mine adits, ventilation shafts and mine shafts to reduce the emission of radon gas. Ventilation shafts will be backfilled using gravel and then plugged with a 2-5 foot thick layer of concrete. ERS has estimated that 100 to 200 yards of gravel would be required to fill each ventilation shaft. Mine adits and openings will be filled with earth fill and plugged with concrete. ERS has identified two mine ventilation shafts, one adit, and one vertical mine shaft located on the Brown-Vandever-Nanabah site and two adits located at the Desiderio site.

Phase 3 Activities

Phase 3 would consist of erecting warning signs around the steep tailing piles which are not frequently visited by the local population. The warning signs will be in English, Spanish and Navajo.

2. Contribution to remedial performance

The removal actions proposed in this Action Memorandum will alleviate all the potential immediate hazards. Once this "hot spot control" response action is completed, additional studies will be undertaken to determine if additional removal or remedial actions are warranted. ERS believes that the proposed actions will not adversely impact but enhance any future remedial activities.

3. Description of alternative technologies

ERS is not planning to utilize any alternative technologies during this response action. Activities planned for this removal action are considered to be the most effective and best available technologies in alleviating the identified hazards.

4. Applicable or relevant and appropriate requirements (ARARS)

Federal ARARs -- Toxic Substance Control Act
Resource Conservation and Recovery Act
Clean Air Act
Surface, Exploration, Mining and Reclamation of Lands (25 CFR Part 216)
Uranium Mill Tailings Radiation Control Act

Navajo Nation ARARs -- None identified at this time

B. ESTIMATED COSTS

Appendix B contains a cost break down generated by the Removal Cost Management System. It is estimated that the removal action will cost $629,770.00. Of this, an estimated $381,845 comes from Regional Allowances. This project estimation includes a 15% Extramural Contingency factor and a 10% Project Contingency factor. This cost projection includes use of Davis-Bacon wage provisions.

ERS estimates that it will take approximately three weeks to complete site work.

VI. EXPECTED CHANGE IN THE SITUATION SHOULD ACTION BE DELAYED OR NOT TAKEN

If immediate action is not taken at the Site, the local population will continue to be exposed to potentially hazardous yearly doses of gamma radiation and radionuclides. It is unlikely that the remedial program could clean-up the sites within the upcoming year.

VII. OUTSTANDING POLICY ISSUES

This removal action is considered to be nationally significant. Pursuant to OSWER Directive 9360.0-19, removal actions involving mining sites, radiation sites and those occurring on tribal lands are subjected to EPA Headquarters concurrence. Therefore, this action memo will be routed to Headquarters for concurrance.

VIII. ENFORCEMENT

See Appendix C

IX. RECOMMENDATION

This decision document represents the selected removal action for the Bluewater Uranium Mine Sites, Navajo Nation, New Mexico in accordance with CERCLA, as amended by SARA, and, is not inconsistent with, the National Contingency Plan. This decision is based on the administrative record for the site.

The total project ceiling is estimated to be $629,770.00.

Of this, an estimated $381,845.00 comes from the Regional Removal Allowance. This includes both a 15% Extramural Contingency and 10% Project Contingency factor. Because conditions at the site meet the NCP section 300.415(b)(2) criteria for removal, I recommend your approval of the proposed removal action.

J. Wilson
Approval Signature

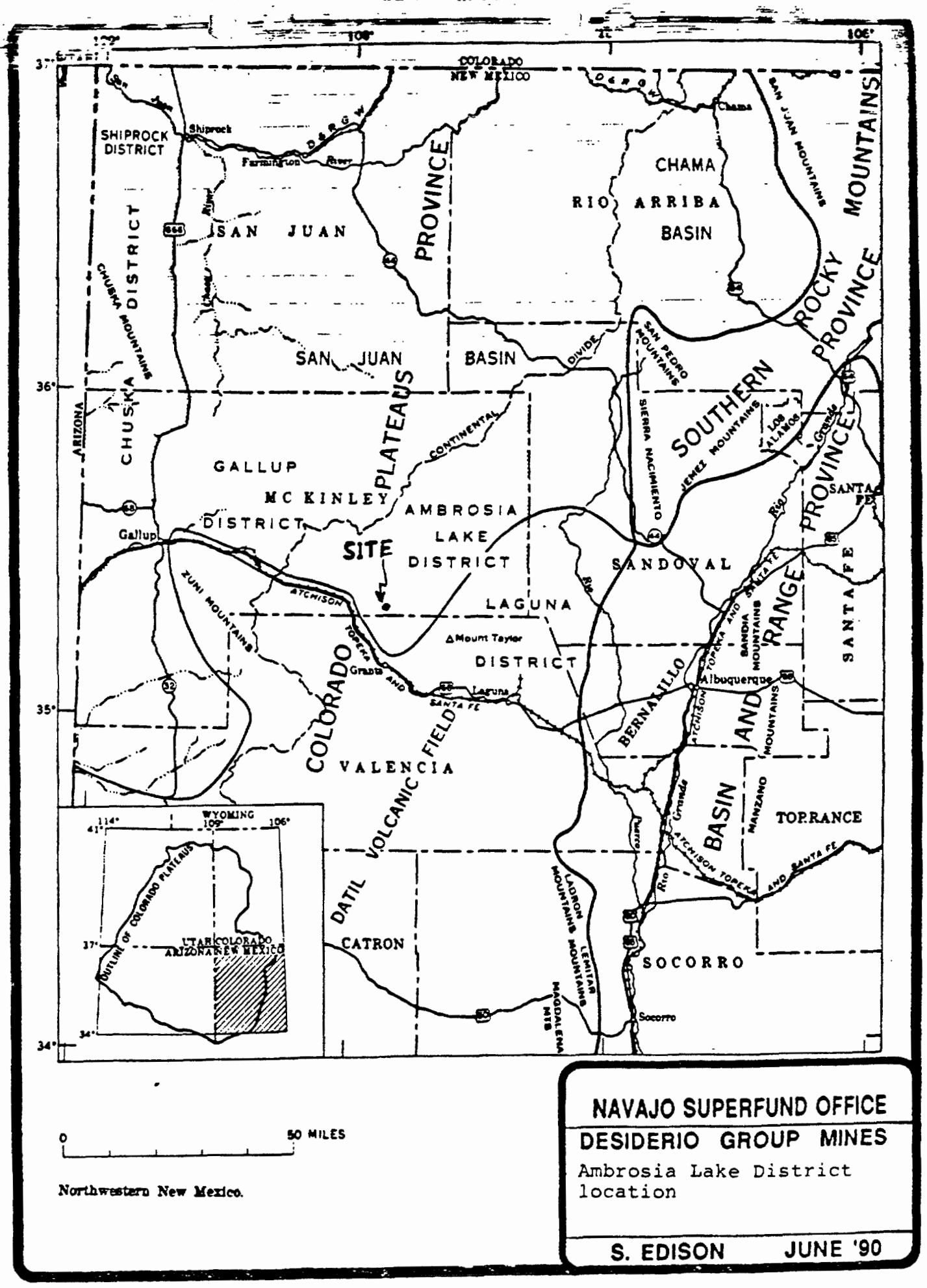
6-13-91
Date

Disapproval Signature

Date

APPENDIX A

(Contains Site Map and ATSDR Health Advisory and Consultation)



Northwestern New Mexico.

Figure 1 After Hilpert,L.S. Ref. 14

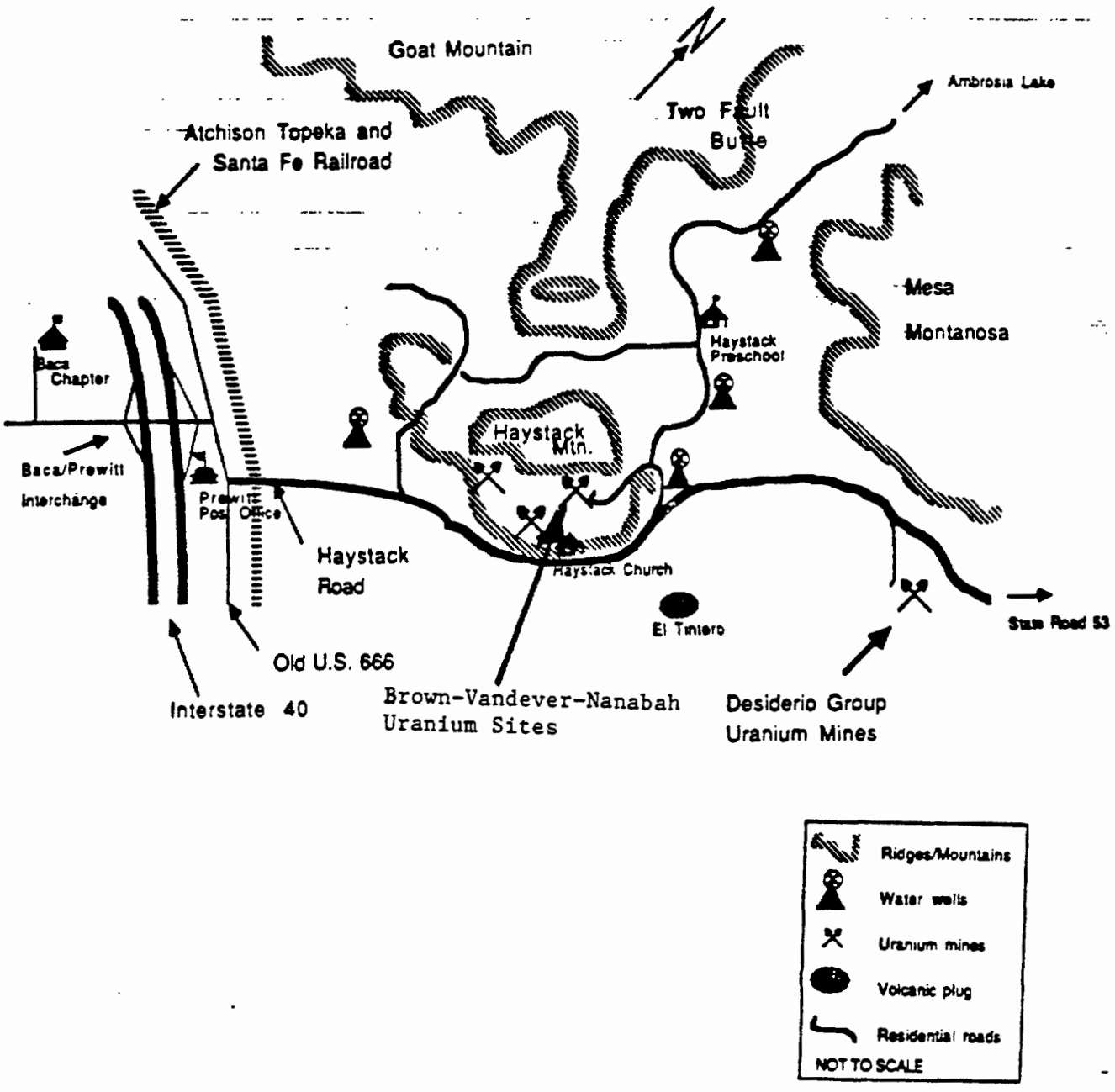

Goat Mountain
N
Two Fault Butte
Ambrosia Lake
Atchison Topeka and Santa Fe Railroad
Mesa Montanosa
Haystack Preschool
Baca Chapter
Haystack Mtn.
Baca/Prewitt Interchange
Prewitt Post Office
Haystack Road
Haystack Church
El Tintero
State Road 53
Old U.S. 666
Interstate 40
Brown-Vandever-Nanabah Uranium Sites
Desiderio Group Uranium Mines
Ridges/Mountains
Water wells
Uranium mines
Volcanic plug
Residential roads
NOT TO SCALE
NAVAJO SUPERFUND OFFICE
DESIDERIO GROUP MINES
Site location
S. EDISON
JUNE '90

Figure 3

April 22, 1991

Health Physicist
Federal Facilities Activity, OD, DHAC, ATSDR

Health Consultation: Navajo-Brown Vandever and Navajo-Desiderio Uranium Mining areas, Bluewater, New Mexico.

William Nelson, ATSDR, Region IX
Through: Director, DHAC, ATSDR_____
Acting Chief, ERCB, DHAC, ATSDR_____

BACKGROUND AND STATEMENT OF ISSUES

On November 21, 1990, the Agency for Toxic Substances and Disease Registry (ATSDR) released a Public Health Advisory notifying the Environmental Protection Agency (EPA) that conditions existing at several abandoned uranium mining areas in new Mexico posed a potential significant health hazard. These adverse conditions include the presence of radioactive materials, physical hazards, and heavy metals on or near residential areas where approximately 500 people reside including many children. One result of the Public Health Advisory was that EPA Region IX and the EPA Las Vegas facility collected soil, water, and air samples from the sites. These were analyzed for radioactive materials and heavy metals.

Following the collection and analysis of these samples, EPA Region IX requested the assistance of ATSDR (see attachment) to further evaluate the acute and chronic radiological hazard posed to those individuals living on or near the sites discussed in the Public Health Advisory. The EPA also requested that ATSDR assist in the estimation of the risk for those individuals living near these sites based on a two year exposure, for those individuals living near these sites.

The EPA collected soil, water, and air samples at the Brown Vandever (BV) mine area and the Desiderio (ND) mine areas. Each area was divided into sections and subdivided into stations. Using standard radiation detection equipment, a background reading for each area was measured and external environmental radiation levels were measured for each station within areas. In the BV area, the net (background subtracted) radiation levels ranged from three microroentgens per hour (μR/h) to over 750 μR/h at waist level. On contact with the ground, the maximum level exceeded 1,225 μR/h. At the ND areas, the net radiation levels ranged from background to

over 375 μR/h at waist level and over 850 μR/h on contact. The waist level measurements are indicative of human exposure levels, whereas, the contact measurements suggest the emission rate of the radioactive materials.

Potable water samples were obtained from taps at both locations, a livestock well, and the nearby preschool water supply well. All amounts of detected radionuclides were below the Primary Drinking Water Standards for radioactive materials.

Soil samples collected and analyzed for both radium (Ra-226/228) and uranium isotopes (U-233/234/235/238) showed that there were high levels of these radionuclides in the soils. The maximum levels of radioisotopes detected in surface soils (top 15 centimeters) at the BV area were: for radium in excess of 260 picocuries per gram soil (pCi/g) and for uranium species more than 300 pCi/g. At the ND area, the maximum levels of radium detected in surface soils exceeded 30 pCi/g and for uranium, the maximum level exceeded 390 pCi/g.

Radon (Rn-222) flux measurements from the waste piles were also measured at several stations within the BV area. These results showed that the maximum emission rate of radon was 67 pCi per square meter per second. No measurements from the ND area were supplied to ATSDR.

Samples were also collected to determine the heavy metal content of soils and water as this was a concern of ATSDR in the Public Health Advisory. The data supplied to ATSDR suggest all concentrations in soil and water were below levels of concern.

The presence of physical hazards existing at these sites was also reported by the EPA, confirming earlier ATSDR concerns. The physical hazards included open mine shafts, ventilation shafts, mining pits, and unstable structures.

DOCUMENTS AND INFORMATION REVIEWED

The material reviewed for the preparation of this consultation included the ATSDR Public Health Advisory, the Code of Federal Regulations (CFR), the National Council on Radiation Protection and Measurements (NCRP) Report 91 on the Recommendations on Limits for Exposure to Ionizing Radiation, the National Academy of Sciences BEIR V report, and sampling results from the EPA dated January 29, 1991.

DISCUSSION

ATSDR reviewed these recent data and correlated the gamma radiation levels found by the EPA at the sites with the levels believed to exist at the time the Public Health Advisory was developed. These latest results verified ATSDR's concerns as expressed in the Public Health Advisory. Indeed, in some locations measured levels were twice the 500 µR/h that ATSDR estimated could be present.

The radiation exposure levels in selected areas of these sites may represent an acute hazard to those individuals that might frequent such areas. Because of the physical nature of gamma radiation, factors such as proximity to the radioactive areas and the time spent in the areas, will affect the magnitude of exposure and potential health effects. For example, if an individual is 10 feet from a pile for an hour and another individual is 20 feet from the same pile for an hour, the individual 20 feet from the pile could receive a dose one fourth that of the other individual. Therefore, the more time spent closer to these waste piles or other areas with elevated radiation levels, the associated health hazards may become more of an acute than a chronic health concern. This would especially be true for local residents who frequently work or play among the piles.

According to the NCRP, the continuous or frequent annual external radiation exposure to a population should not exceed 100 millirem per year (mrem/y); the limit of 500 mrem/y should be applied for an infrequent annual exposure. If the proposed limit of 100 mrem/y for the public is used for these sites, the annual radiation exposure limit at the Navajo sites in question would easily be exceeded during a year.

Using the above criteria, the radiation exposure rates near the subject residential areas would be considered as representative of a chronic, low level radiation exposure. There are also data to suggest that an imminent radiological health hazard exists to individuals who might frequent the waste piles. In the Public Health Advisory, ATSDR defined an imminent radiation health hazard based on 10 CFR 20.104-105. The levels measured at the waste piles at these sites meet these requirements. Additional support for classifying these sites as an imminent public health threat can be found in 40 CFR 190.10 which states that the annual radiation exposure to the entire body should not exceed 25 mrem per year. The 40 CFR 190.10 exposure limit includes releases of radioactive materials, except radon and its decay products, from all phases of operations using uranium, including mining and milling operations. Because some piles have emission rates of approximately one mR/h, which is nearly equivalent to one mrem/h, the required

40 CFR 190.10 annual exposure limit could be reached after several short periods of exposure.

During the visits ATSDR has made to these particular sites, uranium ore bearing materials were observed both next to residential areas and in structural components of the residences. Because ATSDR did not receive any sampling data or monitoring data concerning Rn-222 levels in residential areas, the extent of any exposure from the radon cannot adequately be determined. Such data would be required to complete the evaluation of the public health hazards.

EPA Region IX also requested that ATSDR determine if the risk of exposure exceeded the $1x10^{-4}$ risk level as described in the National Contingency Plan for removal action or remedial action at a site. Because this request involves risk analysis and risk assessment for the purposes of remediation and clean-up, it is the purview of the EPA, not ATSDR, to address risk management issues; therefore, ATSDR cannot respond directly to this request. However, ATSDR refers the EPA Region IX to the ATSDR Health Advisory and the discussion of the BEIR V report that discusses the risk of excess cancer mortality for males and females exposed to ionizing radiation at a rate of 100 milliroentgens per year (mR/y). These risks are for a lifetime exposure of 70 years.

The Navajo people do not tend to be a migratory population but, have a tendency to remain close to their ancestral lands and homes. Thus, long-term exposure to varying levels of radiation as present at these locations must be considered, not the two year exposure as discussed in the EPA letter of January 29, 1991. The exposures to these levels of ionizing radiation have been occurring for much longer than the two years it would take for a remedial removal action to take place.

CONCLUSIONS

Based on the available data and interpretation of existing Federal Guidelines and recommendations of the NCRP, ATSDR concludes that:

1. radiation exposure at these sites could result in adverse health effects depending on the amount of time spent in radioactively contaminated areas. The residential areas appear to be relatively safe; whereas, if much time is spent in areas containing the waste piles, an imminent health problem could surface;

2. the soil sampling data indicated that the levels of radium-226 in the top 15 cm of soils exceed the regulatory limits (40 CFR 192);

3. the data indicate that radon-222 (Rn-222) emission rates from the abandoned waste piles exceed the guidelines of 20 pCi per square meter per second (40 CFR 192);

4. heavy metals do not pose a health hazard to the residents of these areas as initially believed in the Public Health Advisory;

5. the physical hazards at the site still pose a public health concern and have not been addressed with regards to site safety both for residents and potential workers at these sites.

RECOMMENDATIONS

Because of the nature of gamma radiation, simple but effective measures can be implemented to reduce the health hazards. Since the levels of radiation detected are a public health hazard and the physical hazards are still present at these sites, ATSDR is making the following recommendations to protect the public health at the Brown Vandever and Desiderio mining areas.

1. Although the sampling procedures sufficiently determined the levels of radioactive materials in the areas of the mine wastes, ATSDR feels that additional air samples for Rn-222 need to be collected in the residential areas. The Rn-222 data should be collected, analyzed, and submitted to ATSDR as quickly as time permits.

2. Because of the physical nature of the contaminants at these sites, it would be prudent to restrict site access by an appropriate and approved method.

3. An additional site safety plan for residents should be in place to address the radioactive and physical hazards at this site besides the site safety plan in place for on-site workers.

4. The recommendations of ATSDR as listed in the Public Health Advisory are still applicable to this site including the possibility of exposure studies of local residents.

Paul A. Charp, Ph.D.

Response to EPA comments of April 15, 1991 draft of Navajo Consultation. Each comment has been numbered on the copy faxed to ATSDR and these response numbers refer to the numbered comments of EPA.

1.

2. the comment refers to the example given of an individual at 10 feet or 20 feet from a pile. The consultation does not state that a risk assessment is needed. The text is an example explaining that as an individual approaches a radioactive pile, that person's exposure increases accordingly.

3. This paragraph has been omitted and replaced with language from the NCRP and recommendations that the NCRP has published. The request for the time needed to remove the material is related to risk assessment and risk management which are not the purview of ATSDR to address.

4. The data used to suggest the imminent radiological health threat is the data of radiation levels supplied to ATSDR by the EPA. Radiological data is different than data normally seen by Superfund. The risks associated with radiation are better known that the risks associated with chemicals. The risks with radiation vary as a function of time in an area, distance from the material (inverse square law), and the degree and type of shielding between the radioactive material and a population.

5. The text of 10 CFR 20.104-105 is the Federal Regulation and this can be found by any individual who so requests the text. No quote is necessary.

6. The regulations of 40 CFR 190.10 is not a risk assessment but another Federal regulation dealing with radiation exposures.

7. With respect to gamma radiation, health physicists world-wide generally consider a exposure of one roentgen to be equivalent to one rem because the quality factor (QF) of gamma radiation is equal to one. This is explained using the relationship of dose = exposure x QF. For alpha radiation, the QF = 20, for beta QF = 1. Neutron radiation varies by energy of the neutrons.

8. The Rn-222 data is been collected by the Navajo Superfund Office (NSO). The NSO should relay those data to EPA and EPA to ATSDR.

9. This comment refers to the letter received by ATSDR.

10. The local residents can stay in the area with stipulations. It is not highly likely that these people will agree to be relocated during clean-up.

11.

12. Previous text stated that the Rn-222 data are needed to complete the impact on public health (top of page 6).

13. The recommendation does not state what remedy is to be used but that "an appropriate and approved method" should be used. The procedure is left to the EPA to decide.

14. Because it is foreseeable that the residents will not be relocated, the safety plan needs to address the safety of the residents. In the final draft of the consultation, the last recommendation is that the recommendations of the Public Health Advisory are still appropriate, i.e. education programs conducted by ATSDR.

15. The consultation states that both an immediate health concern and a chronic concern are present at the sites based on the location of an individual.

Paul A. Charp, Ph.D.

NOV 2 1 1990

The Honorable William K. Reilly
Administrator
U.S. Environmental Protection Agency
401 M Street, S.W.
Washington, D.C. 20460

Dear Mr. Reilly:

With this letter, we are enclosing the Public Health Advisory for radiation exposure, potential exposure to heavy metals, and physical hazards associated with the Navajo-Brown Vandever and Navajo-Desiderio Uranium Mining Areas near Bluewater, New Mexico.

The Agency for Toxic Substances and Disease Registry (ATSDR) has evaluated the available environmental information for the inoperative Navajo-Brown Vandever and Navajo-Desiderio Uranium Mining Areas. As a result of this evaluation, we consider the sites a potentially serious threat to human health because of the presence of uranium mine wastes, associated radon emission, and the potential presence of heavy metals in residential areas. These areas also contain many readily accessible mine shafts and open-pit mining areas. In accordance with Section 104(i)(6)(H) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), ATSDR is recommending that you evaluate the sites for inclusion on the National Priorities List.

In the Public Health Advisory, ATSDR recommends the following actions:

1. The Environmental Protection Agency (EPA) should initiate data collection to characterize the contamination and its extent.

2. If the data being collected indicate that residents face an imminent radiation health hazard, immediate action should be taken to mitigate the hazard. If appropriate, this action could include the temporary relocation of affected residents until the hazard has been removed or mitigated.

3. Public water supplies and private wells in the area should be sampled immediately for radioactive materials and heavy metals.

The enclosed Public Health Advisory expresses our concerns and addresses measures to eliminate human health hazards. The Assistant Administrator of ATSDR, Dr. Barry L. Johnson, has notified the EPA Region IX Administrator, the New Mexico State Department of Health, and the Indian Health Service about this Advisory.

Sincerely,

William L. Roper, M.D., M.P.H.
Administrator

Enclosure

cc:
EPA Administrator, Region IX
New Mexico State Department of Health
Indian Health Service
Indian Health Service, Navahoe Area Office
PHS Region VI
ATSDR Region VI
ATSDR Region IX

AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY
PUBLIC HEALTH ADVISORY

NAVAJO-BROWN VANDEVER
AND
NAVAJO-DESIDERIO URANIUM MINING AREAS
NAVAJO NATION
BLUEWATER, NEW MEXICO

November 21, 1990

Statement of Purpose

This Public Health Advisory is issued to inform the Environmental Protection Agency (EPA), the Navajo Nation, the Indian Health Service (IHS), the Bureau of Indian Affairs (BIA), the State of New Mexico, and the public of a potential significant environmental hazard to human health near Bluewater, New Mexico. After evaluating available information (1,2) and visiting the area, the Agency for Toxic Substances and Disease Registry (ATSDR) has determined that this Public Health Advisory is warranted for the Navajo-Brown Vandever (N-BV) and Navajo-Desiderio (N-D) Uranium Mining Areas. The presence of uranium-containing radioactive mine wastes, areas potentially contaminated with heavy metals, and many physical hazards form the basis of this Advisory. Because of these potential hazards to human health, the ATSDR is recommending that these sites be evaluated for inclusion on the National Priorities List.

At the request of the EPA, Region VI, and the Navajo Superfund Office (NSO), the ATSDR initiated preliminary investigations of the radiological, chemical, and physical hazards associated with the N-BV and N-D uranium mines. These sites are not currently on the National Priorities List, but the NSO and the EPA are currently developing Preliminary Site Assessments.

Two site visits by the ATSDR staff were made to the Navajo-Brown Vandever and Navajo-Desiderio Uranium Mining Areas. Field monitoring data were taken at the time of the visits. The ATSDR has concluded, based on the site visits, the data acquired during the visits, and the evaluation of other available information, that radioactive materials potentially hazardous to human health may be present at these sites. These hazardous materials include uranium-containing mine wastes with radiation levels potentially hazardous to human health, areas potentially contaminated with heavy metals at soil concentrations potentially hazardous to human health, and many physical hazards of public health concern. This finding has led to the issuance of this Public Health Advisory.

Background

The N-BV and N-D sites are in Bluewater, about 4 and 9 miles east of Prewitt, New Mexico, respectively (1,2). Both areas are in the Ambrosia Lake subdistrict of the Grants Uranium Mining District. Access to the areas is over improved dirt roads. These mining areas are in agricultural rural settings and adjacent to residential properties. Both mines are located on land owned by the Navajo Nation and held in trust by the Bureau of Indian Affairs, United States Department of Interior. The current owner of the N-BV mine is Mr. Brown Vandever, who lives at the site with his extended family. The owner of the N-D mine is Mrs. Jenny Desiderio, who inherited the mine from her deceased husband and lives on the site with her extended family.

The NSO estimates that at each site there are approximately 65 people, 30 of whom are children. Less than 3 miles from the sites is a preschool with a student enrollment of about 30 children. The NSO also estimates that about 500 persons are potentially impacted by environmental hazards at these sites.

A potable municipal-type water supply system for the area is derived from a well installed by the IHS. The NSO estimates depth of the well is about 1,100 feet. However, the NSO believes that not all residents are on this water system. The wells used by those residences not on the public supply are well systems operated by windmills.

The N-BV area encompasses about 155 acres (1), and the N-D mine covers about 130 acres (2). Within a mile of the N-BV mine is the Navajo-Nanabah Vandever (N-NV) mine site. These sites initially were open-pit mining operations. Besides the open-pit operations, the N-BV area operated as a subsurface mine. The site therefore includes horizontal mine shafts and ventilation shafts, some of which are almost vertical. During the site visits, the ATSDR observed that household wastes had been deposited into some of these shafts. It was apparent that local residents were still using these shafts for solid waste disposal.

Historically, the N-BV mine was operated periodically from 1952 to 1966 by various companies including Santa Fe Uranium, Federal Uranium Mesa Mining Company, and the Cibola Mining Company. During the operations of this mine, conventional mining techniques were used. The ore removed from the mine was believed to be sorted by hand and shipped to regional mills located near Ambrosia Lake or Shiprock, New Mexico, or the Durango, Colorado, areas. In its draft Preliminary Assessment of the site, the NSO documented that over 25,000 tons were removed from the mine. The ore processing produced about 49 tons of uranium oxide (U_3O_8) and over 37 tons of vanadium pentoxide (V_2O_5). Ores not meeting the screening criteria for uranium content were discarded at the mine site. These ores now line the roads leading to the Brown-Vandever residential and mine areas (1).

From 1952 to 1957, the N-D mine was operated by "Sante Fe" (exact name unknown, may not be the same company as previously mentioned) and the Hanosh Mines from Grants, New Mexico. The mining technique involved removing the soil overburden with heavy equipment followed by drilling and blasting the ores loose. The ores then were trucked to area mills for processing. Ores not meeting the minimum requirements for uranium content were disposed of at on-site locations. The NSO estimates that the 11,110 tons of ore removed by this operation contained over 83,000 pounds of U_3O_8 and over 17,500 pounds of V_2O_5 (2).

At both the N-BV and the N-D mines, the physical hazards are of particular concern to the ATSDR because of the number of children known to reside in the areas. The physical hazards observed by ATSDR include both open mine shafts and open pits. Because of the depth of the shafts and the unrestricted access, an inadvertent intruder either entering or falling into the shafts could be difficult to find and rescue.

Explanation of Terms

This document uses terms associated with radioactivity and dose resulting from radiation exposure. These terms are defined here.

curie -- A curie (abbreviated Ci) is the unit used to measure the amount of radioactivity. It is equal to the amount of radioactivity in 1 gram of radium (1 gram = 1/28 ounce or 0.0022046 lb). A picocurie (pCi) is one trillionth of a curie (1×10^{-12}). One trillionth is the same as 1 second in 320 centuries or 1 inch in 16 million miles. Exposure levels of the radioactive gas radon are commonly expressed as picocuries per liter of gas (pCi/L).

roentgen -- A roentgen (abbreviated R) is used to measure exposure to ionizing radiation, such as gamma rays or X-rays. Gamma radiation is energy given off by certain radioactive substances, such as uranium and radium. Basically, a roentgen defines the amount of energy given off by these radioactive substances into the air. An exposure of 1 R = 87.7 rads per 1 gram of air.

rad -- The abbreviation "rad" stands for radiation absorbed dose. It measures how much radiation is absorbed by a material after exposure to radiation. It is equal to 100 ergs of energy per gram of material (an erg measures energy).

rem -- The abbreviation "rem" stands for roentgen equivalent man. It is a function of the radiation absorbed dose (rad) and the type (or quality) of radiation. In terms of radiation quality, gamma rays are the least harmful internally to humans and alpha particles are the most harmful. The effect of 1 rem is approximately the same as that of 1 R of X-ray or gamma ray radiation. A millirem = 1/1-thousandth of a rem, the same as a dollar in $1,000. A microrem = 1/1-millionth of a rem, the same as 1 minute in 2 years or 1 inch in 16 miles. Throughout the United States, the average natural radiation exposure (called "background levels") is nearly 300 millirems per year. This includes exposure to radon.

Background radiation occurs from natural sources in the earth's crust. Several naturally occurring radioactive materials contribute to this source of radiation. These include, but are not limited to, uranium, thorium, rubidium, and a small percentage of potassium. Other sources contributing to the background include fallout from cosmic radiation, materials made radioactive as a result of interactions with the cosmic radiation, and nuclear weapons testing. A measurement of the background radiation was collected at Prewitt, New Mexico, approximately 3 miles from these sites by the ATSDR and the NSO. Using radiation detectors sensitive to gamma radiation, the background radiation at Prewitt was estimated to be 6 microroentgens per hour (uR/h). This is equivalent to an annual exposure of 53 millirem, not including radon.

Basis for Advisory

During the week of July 24-27, 1990, and November 1, 1990, personnel from ATSDR Headquarters and Regions VI and IX offices toured these sites. Accompanying the ATSDR personnel were representatives of the local Navajo chapter and the NSO. During the visits, radiation readings were collected by both the ATSDR and the NSO. Discussions also were held with officials and members of the Navajo Nation concerning life-styles, populations, health concerns, and land use in these areas.

A. Navajo-Brown Vandever (N-BV) Site

Along the roadbed leading to the Navajo-Brown Vandever site, the area was littered with rocks and ore tailings. Mine tailings from the nearby Nanabah Vandever mine were within 100 feet from the roadbed. These piles were partially overgrown with vegetation. Within the materials along the roadbed, the uranium ores (yellowish material) were clearly visible. Environmental radiation readings along the road, obtained with a calibrated Ludlum Model 19 gamma radiation detector equipped with an NaI(Tl) scintillator, ranged from approximately 50 microroentgens per hour (uR/h) to over 500 uR/h, whereas the naturally occurring background radiation reading was 6 uR/h. The background radiation measurements were obtained in Prewitt, New Mexico, approximately 3 miles from the sites. Radiation monitoring evidence also suggested that radioactive material had migrated off-site because of both wind-borne distribution and surface runoff during seasonal rains. Additional radiation monitoring indicated that some residential structures contained radioactive material in the foundations and that radioactive materials were also present within 20 feet of the residential areas.

At the main mine shaft located in the pit-mined area, ore tailings were randomly piled around the site and radiation readings were elevated above background. A horizontal shaft entering the mountain was observed; and during discussions with local residents, it was mentioned that the shaft branches into three sections. Entrance to this mine shaft is not restricted. Vertical ventilation shafts were also observed; one shaft was about 10 degrees from vertical. A small shack was constructed over this

ventilation shaft, however, access to the shaft was not effectively restricted. Located near the residential areas were open adits (shafts) being used as solid waste disposal areas by the local residents. These adits may run at least 300 feet in length or depth. The residential areas are less than 200 feet from several adits, and access to these adits is also unrestricted.

Although air sampling data are lacking, because of the uranium content of these mines, the shafts provide an excellent path for the release of radon, a naturally occurring by-product of uranium decay. It is reasonable to infer that the release of radon from these mines could elevate ambient radon to levels potentially hazardous to human health at this site.

During mining operations, analysis of the ores indicated the presence of heavy metals. These included vanadium, arsenic, barium, chromium, magnesium, manganese, strontium, titanium, and zirconium. Leaching may have occurred from these ores; however, no analyses of environmental samples are available to verify the presence of these contaminants. Although recent sampling information is lacking, the potential exists for humans to be exposed to these contaminants through ingestion or inhalation.

B. Navajo-Desiderio (N-D) Site

The Navajo-Desiderio mine is a series of open-pit areas of approximately 30 to 50 feet in depth and of varying lengths. The radiation readings at this site were about 50 uR/h. No restricted access to the pits was observed during the site visit; children play and livestock graze freely in the area, and residential areas are within 100 yards of the pits.

Through a Navajo interpreter, the owner of the mine, Mrs. Jenny Desiderio, informed us that her grandson fell into one of the pits during a sledding accident. The child, who reportedly suffered brain damage, died a few years after the accident. According to Mrs. Desiderio, at least 18 livestock died after ingesting contaminated rainwater that reportedly collects in the pits. Whether the dead animals were examined by a veterinarian is not known. Although sampling data are lacking, the NSO officials believe the animals may have died after ingesting heavy metals which may have leached from the ores into the pit areas.

C. Discussion of Site-related Radiological Contaminants

Of the verified contaminants in these areas, those of concern are uranium and a member of its decay series, radon. Of the naturally occurring isotopes of uranium, uranium-238 (U-238) is the most abundant, present at concentrations greater than 99 percent. The primary mode of decay is via two alpha particles, each with a decay energy of approximately 4.2 million electron volts (MeV). The decay chain of which U-238 is the parent results in the production of both radium-226 and radon-222 and ultimately

terminates with stable lead-206. During this decay series, beta particles and gamma rays are produced as well as additional alpha particles, all at different decay energies (3). Because uranium is ubiquitous in nature, the daily human dietary intake is approximately 1.9 micrograms (4). Therefore, the body normally contains an estimated 90 micrograms of uranium. This corresponds to a body burden of about 30 picocuries. Of this amount, about 66 percent is associated with the skeleton; the remainder is in the soft tissues. The biological half-life is 100 days for whole body and 15 days for the kidneys (4).

After ingestion, the fractional uptake of uranium into the blood is 0.05 for water-soluble inorganic forms and 0.002 for water-insoluble forms (5). The critical organs for ingestion are the skeleton and kidneys. The lung surfaces are the critical organ after inhalation, although there is some solubilization of deposited uranium followed by absorption or ingestion (4).

Because Rn-222 is an inert gas, most of the inhaled gas is exhaled, with only that which decayed potentially remaining within the lungs. These radioactive materials deposited within the lung expose the bronchial epithelium lining the respiratory system, resulting in an elevated risk of lung cancer (5,6). Exposure to radon and radon progeny has been directly correlated with the appearance of lung cancer in humans. The first epidemiological studies of radon exposure were conducted in 1879, in Europe. Since then, such studies have been conducted worldwide and many are still in progress. The studies involve uranium miners and show increasing risks of lung carcinomas as accumulated exposure to these products increased (6).

Rn-222 decays by emitting an alpha particle with an energy of approximately 5.5 MeV and gamma rays with an energy of 0.51 MeV. The half-life of Rn-222 is 3.8 days (3). The decay products are also radioactive, emitting mostly beta particles and gamma rays with an alpha particle released during one decay step. These radon progeny, with half-lives ranging from seconds to over 20 years, ultimately decay to a stable (nonradioactive) form of lead.

The effects of biological exposure to radon are difficult to evaluate. Radon is inert and therefore does not attach to surfaces. However, the decay progeny are charged particles and can electrostatically attach to surfaces. Most progeny immediately attach to aerosols. The ratio of attached progeny to unattached progeny is important in dose calculations for as the ratio increases, the radiation dose to lung surfaces increases. Other factors affecting the lung dose include the ratio of Rn-222 to its progeny, the breathing patterns, lung characteristics, sex, and age of the individual exposed. In a recent report from the National Research Council (NRC), the dose from the radon progeny was of greater risk than exposure to radon gas (6). Dose estimates have been published by the National Council on Radiation Protection and Measurements (NCRP) (5). The NCRP estimates that the risk of developing lung cancer

exposure to Rn-222 is 2.1 x 10^{-3} per pCi/L exposure ... environmental conditions. The NCRP also states that the dose to the bronchial regions of a typical working adult because of exposure to Rn-222 is 0.27 rad per year per pCi/L. For a 10-year old child (12 hours active, 12 hours resting), the dose estimate is 0.45 rad/year per pCi/L.

D. Estimates of Radiation Exposure to Local Residents

Because detailed environmental monitoring for heavy metals and radioactive materials has not been supplied to the ATSDR, it is difficult to determine the health risks due to internal uptake of these materials. However, the external exposure to ionizing radiation can be evaluated using the on-scene monitoring results obtained by the ATSDR and the NSO. It is possible that the radiation exposures at these sites poses an imminent radiation health hazard to local residents. For the sites discussed in this Health Advisory, the ATSDR is defining an imminent radiation health hazard as exposures that exceed the regulations for radiation exposure to minors (as described in 10 CFR 20.104) and exposure to the public in areas of unrestricted access (10 CFR 20.105).

The Brown-Vandever mine site is in a residential area. In estimating the annual exposure to external ionizing radiation because of the contaminants in the area, the ATSDR used the following assumptions for a maximally exposed individual (MEI). The MEI would live on the site for 100 percent of the time (24 hours) and 365 days per year. The average exposure, including background in the area, is estimated conservatively to be approximately 125 uR/h. Assuming these values and the 24-hour exposure, the external radiation at this site could result in an individual receiving an external annual exposure of nearly 1 R, about 5 percent of which is from natural background as measured in the vicinity of the site (6 uR/h for 8,760 hours).

The risks of exposure to radiation have been investigated for nearly 100 years and the values have been extensively peer reviewed and accepted by the scientific community. In terms of risk estimates, the NCRP, in 1987, used a risk value for excess cancer mortality of 1 x 10^{-4} per rem per year for whole body exposure (7). In 1990, the NRC released the Biological Effects of Ionizing Radiation Report V, (BEIR V) (8). This report places the risk of excess cancer mortality as a result of continuous lifetime exposure to 0.1 rem per year at 520 for males and 600 for females per 100,000 population (Table 4-2, BEIR V report). Using the estimated population of 500 persons for this area, this would calculate to approximately three excess cancer deaths to residents as a result of exposure to the radiation over an estimated lifetime of 70 years. The American Cancer Society estimates that the expected rate of cancer deaths is on the order of 15 to 25 deaths for a population of 500 individuals.

Furthermore, because of the inherent production of radon released from the uranium-containing ores, the internal radiation dose, especially to the bronchial epithelium of the lungs, could be even higher. In a 1988 report, the NRC stated that the estimated dose to these tissues far exceeds any dose to organs from external natural background radiation (6). As an organ system, the allowable exposure limits for the lungs can exceed the whole body exposure dose limits (7). However, since no specific radon measurements have been made in this area, estimates of potential internal lung exposure to radon cannot be evaluated at this time.

Conclusions

The Agency for Toxic Substances and Disease Registry concludes that the Navajo-Brown Vandever and the Navajo-Desiderio Uranium Mining Areas may pose a potential significant hazard to human health for residents of these areas based on these premises:

1. The predictions of the external exposure model using the estimated exposures to ionizing radiation exceed the recommendations of the National Council on Radiation Protection and Measurements by a factor of 10. These recommendations state that the public exposure limit to continuous or frequent ionizing radiation should not exceed 0.1 rem per year (7), whereas, the estimated exposure to residents in the vicinity of the Brown Vandever mine could be on the order of 1 R (equivalent to 1 rem).

2. Possible human consumption of livestock potentially contaminated with heavy metals following the ingestion of standing water may pose a hazard to human health.

3. The many open mine areas, mine shafts, and the unrestricted access to these areas create a safety hazard.

4. Since evidence suggests that radioactive contaminants are migrating off-site and that heavy metals may be associated with the radioactive material, local food and livestock crops could be contaminated. This could result in a significant internal exposure to both radioactive materials and heavy metals if these crops are ingested.

5. It is apparent that not all local residents are supplied with public water. Because of the runoff and surface contamination around these sites, the water quality of the individual wells may be suspect and hazardous to humans chronically exposed to radioactive materials and heavy metals.

RECOMMENDATIONS

The ATSDR proposes the following health actions to assist local residents:

1. The ATSDR, in coordination with the Navajo Tribal Council, the IHS, the BIA, the State of New Mexico, and other appropriate agencies, will conduct an environmental health education program to advise the public and medical community of the nature and possible consequences of exposure to ionizing radiation and heavy metal contaminants at the N-BV and N-D sites. Health education materials and assistance will be provided to local health care providers and other appropriate local public health officials.

2. The ATSDR will consider conducting health surveillance activities for populations at these sites.

3. The ATSDR will consider conducting a radiation or heavy metal exposure study of the local residents once additional health-related information on the local residents becomes available.

Because of the limited environmental sampling data available to both the ATSDR and the EPA, we recommend the following additional actions to protect the public health of area residents:

4. The responsible environmental regulatory agencies should within the calendar quarter, initiate data collection efforts to begin the characterization and determination of the extent of the radioactive contamination and possible presence of heavy metals. This sampling should include public water supplies and private wells in the area. Those wells exceeding standards should not be used for potable water and residents should be supplied with alternate potable water.

5. During this phase, personal radiation dosimeters and radon detection devices should be provided by the appropriate agencies to local residents to begin to estimate the external radiation exposure being received.

6. During these environmental studies and personal monitoring efforts, if the data being collected indicates that an imminent radiation health hazard exists to the area residents, then immediate steps, including consultation with the ATSDR, should be taken to mitigate that health hazard.

7. The mitigation or remediation would include, as appropriate, dissociation of local residents from the site until the direct public health hazard is removed. The remediation of the public health hazard should occur in the most expeditious manner consistent with Federal and State environmental protection, health, and radiation protection laws and regulations. Appropriate steps should be taken to protect public health during any removal actions (e.g., dust control, site access restrictions, and monitoring of radiation levels).

8. If these analyses indicate that the radiation exposures would result in a long term, chronic exposure, then applicable measures should be taken by the appropriate remedial regulatory agencies to remediate the public health hazard in the most expeditious manner and consistent with all applicable Federal, Tribal, and State guidelines and recommendations.

9. The appropriate agency should sample biota, food crops, and livestock to ascertain the potential for internal radiation exposure through consumption of contaminated food products and to identify addition potential sources of external exposure.

10. The appropriate responsible agency should take steps to prevent access to or otherwise make physically safe the various open mine areas, pits, and shafts.

11. Governmental agencies and any involved private sector organizations should work closely with Navajo representatives to ensure that cultural awareness and respect are observed and practiced.

For additional information, please contact the ATSDR at the following address:

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APPENDIX B

(Contains RCMS Cost Projection)

FX-4 CBI Determined

FX-4 CBI Determined

FX-4 CBI Determined

FX-4 CBI Determined

FX-4 CBI Determined

FX-5 Agency Communications, FX-7 Enforcement Confidential

FX-5 Agency Communications, FX-7 Enforcement Confidential

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